

PREFATORY NOTE

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RULES FOR THE PREPARATION OF RAILWAY PROJECTS.

(REVISED 1926).

PREFATORY NOTE.

(i) The first edition of the "Rules for the Preparation of Railway Projects" in India was issued by the Director General of Railways in 1890. The second edition was issued in 1893 and reprinted with a few small amendments in 1896. The third edition was issued in 1900 and reprinted with corrections in 1910.

(ii) In 1913 and 1914 the Government of India issued with their Circular letters No. 1725-R.C., dated the 21st June 1913, and No. 432-4374-C., dated the 27th November 1914, stringent orders regarding the preparation of "Construction Estimates" which rendered obsolete the classification of estimates contained in Chapter V of the current edition of the "Rules for the Preparation of Railway Projects." For this and other reasons revised rules were drafted: the draft rules were circulated for criticism to the Agents of the principal railways of India with the Railway Board's letter No. 1458-R.C., dated the 27th May 1913.

(iii) Several railway administrations objected to the draft rules and were of opinion that "the compilation might be usefully published for information and guidance in the preparation of railway projects, but not as Government Regulations of universal application."

(iv) Revised "Rules for the Preparation of Railway Projects" in which an attempt was made to meet the objections referred to in paragraph (iii) above were issued in 1918 as Technical Paper No. 192. These rules differed also from the old rules in that prominence was given to the need for careful estimates of Traffic Earnings and Working Expenses.

(v) Under Railway Board's letter No. 666-P. of 30th July 1921 the 1900 Rules were definitely cancelled and orders were issued that the rules published in Technical Paper No. 192 were to be adopted in their place.

(vi) In the present issue those parts of the matter in the 1918 edition which were in the nature of advice rather than rules have been omitted, their substance with occasional advice, more especially on the estimation of traffic earnings and working expenses, will be found in "Notes on the Preparation of Railway Projects" issued as Technical Paper No. 256.

The results of the Traffic Survey are made the basis for fixing, in ordinary cases, the standard of construction to be adopted. The standards of construction as classified in the annexure to Railway Board's letter No. 598-P. of the 18th June 1926, have been reproduced for ease of reference, re-worded where necessary to accord with the revised Schedule of Dimensions for Standard and Metre Gauges, and revised rules for land widths to be taken up.

Paragraph 155 of the 1918 issue stated that a construction estimate based on "Preliminary Survey" was the only estimate on which sanction for commencement of construction could ordinarily be granted by the Secretary of State or the Railway Board. The present issue provides that the decision whether a line is to be built or not will usually rest on the results of the "Preliminary Survey" considered in conjunction with the Traffic Survey, and that a "Detailed Survey" (called in these rules a "Final Location Survey") will not ordinarily be taken in hand until it has been decided to construct the line.

RULES FOR THE PREPARATION OF RAILWAY PROJECTS.

(REVISED 1926.)

CHAPTER I.

INTRODUCTORY.

1. In addition to the Rules herein contained, the following should be carefully studied during the preparation of a project:—

- (i) Rules for the Opening of a Railway.
- (ii) Schedule of Maximum and Minimum Dimensions.
- (iii) Land Acquisition Act and Rules relating to the Acquisition of Land for Railway Purposes.
- (iv) Government of India, Foreign and Political Department, Resolution No. 202-L., dated the 6th December 1923, concerning the survey, construction and maintenance of railways in Indian States.
- (v) Special rules, if any, issued by the local Governments regarding land acquisition.
- (vi) "Notes on the Preparation of Railway Projects," issued as Technical Paper No. 256.

(vii) The following Technical Papers which will also be found useful:—
Nos. 127, 148, 175, 163, 197, 208 and 243.

2. Railway Projects will, as a rule, be submitted to the Railway Board by the Agent of a Railway, and the words "Railway Administration" wherever they occur in these rules will apply to the Agent of the railway under whose orders the project is being prepared. Wherever the word "Engineer" occurs in the rules for surveys it will apply to the Engineer in charge of the survey party.

3. Railway Administrations have no powers to sanction expenditure on surveys. All estimates for surveys require the sanction of the Railway Board.

4. Sanction to the construction of a railway will, as a rule, be given by the Railway Board on consideration of the Traffic Survey and an Abstract Estimate of the cost of the line on Form N. L. 47, accompanied by an Abstract Estimate of "Junction Arrangements," a narrative report explaining the proposed expenditure under I (8) (b) Workshops, Store Buildings, etc., I (8) (c) Electric Power Station and Sub-station buildings, I (10) Plant Construction, (II) (3) Motors, Lorries, II (4) Steamers and Boats, and the following detailed estimates on the Standard forms prescribed for Construction Estimates:—

	Form.
I (2)—Land	N. L. 17.
I (3) (b)—Tunnels	N. L. 19.
I (4) (a)—Major Bridges	N. L. 22.
I (4) (b)—Minor Bridges	N. L. 23, 24.
I (7)—Detailed Estimate of one mile of permanent-way	N. L. 31.
III—Rolling Stock	N. L. 40.
IV—General Charges	N. L. 41 to 46.

The estimates will be prepared from a Preliminary Survey Report. In special cases, however, the Railway Board might require that the estimates should be prepared from a final location survey report.

5. After sanction to the Abstract Estimate is accorded the Railway Administration should undertake the Final Location Survey, proceed with Land Acquisition and place orders for materials. At the same time the Detailed Construction Estimate should be framed. This estimate should, as soon as completed, be forwarded to the Railway Board whose sanction should be asked to any individual work (e.g., a large bridge) estimated to cost more than Rs. 18 lakhs, to any substantial modifications in the Abstract Estimate and to any excess over the total amount of the sanctioned Abstract Estimate.

CHAPTER II.

PRELIMINARY INVESTIGATION.

1. In order to decide whether the preparation of a project for a proposed railway can be justified, a preliminary investigation should be undertaken by the Railway Administration concerned to determine how the proposed line will fit in with a general scheme of future railway development and what return it is likely to yield on the probable capital expenditure.

2. This preliminary investigation should be based on a careful study of information already available from existing maps, published figures of trade and population of the area to be served, and financial and statistical data of existing railways in similar country.

3. It should be possible for the Railway Administration, from the results of this investigation, to take a preliminary view on the standard of construction suitable in each case.

4. The information collected should be embodied in the report accompanying the estimate for the proposed survey.

CHAPTER III.

STANDARDS OF CONSTRUCTION.

1. Where the country is not inherently difficult the capital cost of the line will in a large measure depend on the standard to which it is constructed. Except where conformity to existing standards may be essential as in the case of the introduction of a new line between parts of an existing system, the standard of construction for a new railway should be determined primarily by the traffic to be carried, and should generally be that which will enable the expected traffic to pay a reasonable return on the capital to be expended.

2. The standards of construction to be followed, which have been classified in the annexure to Railway Board's letter No. 598-P. of 18th June 1926 are reproduced in the following paragraphs, re-worded to accord with the revised Schedules of Dimensions for 5' 6" (hereinafter called the Broad Gauge) and Metre Gauge, and revised rules for land widths to be taken up.

3. The standard chosen for a construction should be followed in its entirety: it is not permissible, for instance, to estimate for a line conforming in some respects to Standard A and in others to Standard B.

4. The use of second-hand rails is permissible provided that they have not lost more than ten per cent. of their weight and, having regard to the volume of traffic expected, that their anticipated life in the new line is not less than ten years.

5. Railway Administrations may decide, on the merits of each particular case, the standard of ballasting necessary on first opening.

Classification of Projects.

6. *Standard H. M. Heavy Mineral Line (5' 6" gauge) or Heavy Metre Gauge Line.*—A line fully equipped to carry the heaviest traffic which is likely to be handled for some years to come on a main line. This standard would generally be applicable to a Broad Gauge line on which the mineral traffic is of such importance as to justify, by economy in operation, the use of specially heavy engines and rolling stock, requiring a heavier class of track than adopted on Standard A railways: or to a Metre Gauge line requiring a capacity beyond that provided by Standard A, but where it is inadvisable on account of cross connections, or for other reasons, to convert to Broad Gauge.

(i) The "Heavy Mineral" (Broad Gauge) line will have to be capable of handling 12 feet stock, in trains of 2·3 tons per foot run, hauled by 2-10-2 locomotives with 28 ton axle loads. The weight of rails to be used has not been finally decided, but will probably be 110 or 115 lbs. per yard. In other respects the specification will generally have to be similar to a Standard A line as given in paragraphs 7 (c) and (d), but there may be cases where a lower grade of equipment will suffice for a few years.

(ii) The Heavy Metre Gauge standard will be built to the following specification:—

(a) The rails will be 75 lbs. F. F.

(b) The bridges will be up to the 1916 (Metre Gauge) standard of loading.

(c) The Station buildings and offices and general Station equipment will be up to the best standard of the parent line.

(d) Stations will be fully interlocked.

7. *Standard A.*—A first class line of the same gauge as the parent line, suitable for a new main through route, or one that will have to carry traffic in excess of—

Broad Gauge—3 million gross ton miles per mile per annum.

Metre Gauge—2 million gross ton miles per mile per annum immediately after opening.

The line will be built to the following specification:—

(a) The rails will be 90 lbs. F. F. for broad gauge and 60 lbs. F. F. for metre gauge.

- (b) On the broad gauge, the minimum standard of loading for bridges will be Standard I of 1926, and on the metre gauge, the bridges will be up to the 1916 Standard of Loading, known as Standard III.
 - (c) Goods sheds, Station buildings and Station equipment generally will be provided according to the best standard of the parent line, and adequate provision will be made for housing the staff.
 - (d) Stations will be fully interlocked.
8. *Standard B*.—A secondary standard for a reasonably good chord or branch line which is expected to carry :—
- Broad Gauge—more than $\frac{1}{2}$ but less than 3 million gross ton miles per mile per annum.
- Metre Gauge—more than $\frac{1}{2}$ but less than 2 million gross ton miles per mile per annum, soon after opening and to develop further.
- A line built to this standard should be adaptable for improvement to Standard A without radical modification.
- The line will be built to the following specification :—
- (a) The minimum weight of rails will be 75 lbs. for the broad gauge and 50 lbs. for the metre gauge.
 - (b) The minimum loading permissible for bridges will be for the broad gauge Standard II of 1926 and for the metre gauge Standard B of 1903 *plus* 25 per cent. If, however, there is reasonable likelihood of the line requiring to be converted to Standard A within the next 35 years, they should be to Standard I of 1926 and to the 1916 Standard (Standard III) respectively.
 - (c) The Station offices and general traffic equipment should be the minimum considered requisite for the traffic on first opening, but should be so designed as to be capable of being improved and **expanded up to** the requirements of a Standard A line with the minimum amount of expenditure.
 - (d) Signalling and interlocking will be according to requirements, the chief considerations, having regard to the question of safety, being the speed and frequency of trains.
9. *Standard C*.—A low standard for a light line of the same gauge as the parent line which does not promise much development and is not expected to require more than, say, 3 trains a day each way, or to carry on the broad gauge more than $\frac{1}{2}$, and on the metre gauge more than $\frac{1}{2}$, million gross ton miles per mile per annum
- (a) The line will be built to the Standard C dimensions provided in the Schedule of Dimensions for Broad and Metre Gauges.
 - (b) The minimum weight of rails permissible will be 60 lbs. for broad gauge and 40 lbs. for metre gauge.
 - (c) Bridges should be up to a minimum of Standard II of 1926 for broad gauge, and Standard V of 1903 *plus* 25 per cent. for metre gauge, and may be provided with duplicated or strengthened second-hand girders.
 - (d) If ballast is not provided, the packing material should be sloped away in both directions from the centre of track to provide proper drainage and thus assist in the preservation of the sleepers.
 - (e) Crossing stations should be provided only at places where trains are booked to cross according to a prepared time table, but there should be a liberal provision of flag stations or halting places to catch traffic.
 - (f) Stations should be provided with rail level platforms and the minimum staff quarters and station offices. All bungalows should be of a cheap type of construction.
 - (g) Permanent-way gang huts should not ordinarily be provided in the first instance.

- (h) No interlocking need be provided. The signals may be limited to outers worked by winches from the station.
 - (i) The speed will be limited to 25 miles per hour on the broad gauge and 20 miles per hour on the metre gauge, or such lower speed as the Government Inspector may direct.
10. *Standard D—Feeder Lines*.—These would comprise all lines built to a lighter standard than Standard C. Such lines are built with the object of encouraging trade relations and thus creating traffic, or for promoting the habit of travelling by rail. They cover all the lightest forms of rail transport which are available if a Standard C line cannot be justified.
- (a) Wherever it is possible to do so without much extra cost, a feeder line should be so located as to be easily convertible to a Standard C line.
 - (b) If a main line with which it connects is a broad gauge, the gauge of a Standard D feeder line should as a rule not be more than 2' 6".
 - (c) Except in some cases of difficult hill country, or for experimental purposes, a smaller gauge feeder line to a metre gauge line should not ordinarily be constructed.
 - (d) The standard of construction may vary in accordance with the requirements of each case from that of a tramway or a Standard C line as described above, to that of a first class narrow gauge railway.

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CHAPTER IV.

RELATIONS WITH THE PUBLIC AND GOVERNMENT DEPARTMENTS.

1. *Notification in Local Gazette.*—Before any survey operations are commenced, a notification in accordance with the terms of Section 4 of the Land Acquisition Act is to be inserted in the Local Government Gazette. This should be arranged for by the Railway Administration as promptly as possible after receipt of sanction to the survey, and is independent of the Notification published in the *Gazette of India* by the Railway Board.

2. *Indian States.*—When the survey of a projected line passes through an Indian State, the Engineer or Traffic Officer must consult the State as to the alignment which would best serve the commercial and other interests of the State; and, while adhering to the general direction indicated in his "Terms of reference", he should endeavour as far as possible to meet the wishes of the State.

3. Before commencing survey operations in Indian State territory, the Engineer or Traffic Officer should satisfy himself that the consent of the State has been obtained.

4. *Damage to Property and Trespass.*—The general sanction for a railway survey, given by the Railway Board, does not authorise any interference with the rights or property of public bodies or private individuals.

5. The permission of the officer commanding should be obtained by the Engineer for the entry of the survey party into any military cantonment, fort, or entrenched post. In the case of a survey passing through a military cantonment or civil station the wishes of the officer-in-charge of the cantonment or civil station should receive due consideration, and his permission should be obtained before any trees are cut or damage done to station property.

6. In the case of a survey passing through an Indian State the wishes of the Resident or Political Agent should be ascertained by the Railway Administration and his permission must, in any case, be obtained before land is entered upon or damage done to trees or other property. Notification under Section 4 of the Land Acquisition Act does not apply to land in Indian State territory.

7. *Compensation for Damage.*—Where damage to private property is unavoidable, compensation should, if practicable, be paid or tendered direct to the owner on the spot by the Engineer before the damage is done. In case of any dispute, the matter should be referred to the local civil authorities to settle with the owner, and the compensation decided upon should be paid as soon as practicable.

8. Should the owner of the property be willing to clear the line himself, he should be allowed to do so and should, in that case, be paid a reasonable sum for labour in addition to compensation for the damage done.

9. *Religious Edifices, etc.*—Every endeavour should be made to avoid interference with religious edifices, burial grounds or other places or objects which may be considered sacred; where such place or object is enclosed, the enclosure should not be entered except with the permission and in the presence of the person in charge. Similarly, all possible steps should be taken to avoid interference with, and prevent the destruction of, ancient remains of archaeological interest.

10. *Interference with Pre-existing Railways, Roads, Canals, etc.*—Whenever the alignment of a new railway passes close to, or involves any alteration to or diversions of, pre-existing railways, roads, canals, etc., or interferes with any works or land appertaining to the same, the written acceptance of the authorities in charge of such railways, roads, canals, etc., to the proposals involved by the construction of the new railway must invariably be obtained before any work thereon is put in hand, and the Railway Administration should, therefore, obtain the views of the responsible authority in such cases during the survey.

11. Enquiry should also be made from the Local Government in the Irrigation Department by the Railway Administration as to whether any dam, or river, diversion, or any work is proposed which would affect the proposed railway in any way. If after consultation with the Irrigation Department it is found that any addition or alteration to the railway would be required, owing to such work as is contemplated by the Irrigation Department being carried out, the Railway Board

should be asked if provision for the addition or alteration should be made in the estimates and plans.

12. *Military Requirements.*—Where the line lies in the vicinity of a military post, camping ground, rifle range or cantonment, the location should be decided by the Engineer in communication with the local military authorities. Should it, however, be found that the military requirements would involve a considerable extra expense in construction, or great inconvenience, to traffic, or would be open to serious objection from an engineering point of view, the matter should be referred to the Railway Board for orders.

13. In the case of important bridges the Railway Administration should consult the local military authorities as to whether a roadway is required, and, if so, what form of roadway is necessary, particularly in regard to carrying heavy lorries and guns.

14. Special attention is drawn to Appendix C to the revised Rules relating to the Acquisition of Land for Railway Purposes.

15. *Assistance from Civil Authorities.*—The local civil authorities should be freely consulted by the Engineer during the progress of the survey operations, and their opinion should have due weight in determining the most profitable route to be followed. They should be asked to use their influence, as far as practicable, to protect the bench-marks, pegs, and other railway marks from removal or injury.

16. The wishes of the local civil authorities should be obtained as to whether roadways suitable for cart or foot-traffic are required on any bridges.

17. The wishes of the local civil authorities should also be ascertained as to headway and width of span in the case of all bridges over navigable rivers.

18. The correct spelling of all towns and villages included in the survey should be taken from the Alphabetical List of Stations, the Gazetteer or, if not found in either, from the civil authorities.

19. As soon as possible after the field work of a survey has been finished, the local civil authorities should be supplied by the Railway Administration with an Index Plan, and requested to supply data necessary for the preparation of estimates of the cost of land for the projected railway: see revised Rules relating to the Acquisition of Land for Railway Purposes, 1918.

20. Local Governments or Administrations concerned should be supplied direct by the Railway Administration with a copy of the project report and construction estimate, together with an index plan and section on a scale of one inch to the mile, on which should be shown the size and position of all waterways and level crossings to be provided. The Local Governments or Administrations concerned should, at the same time, be asked to express their views on the following points which, on receipt, should be forwarded to the Railway Board:—

- (1) alignment,
- (2) waterways, both in connection with existing channels and possible extensions of irrigation,
- (3) headways of bridges over navigable rivers, if any,
- (4) roadways over important bridges (*i.e.*, bridges with spans of 100 feet and over and having a total length of waterway of not less than 1,200 lineal feet, or 600 feet in case the bridge is close to an important trunk road or highway),
- (5) level crossings,
- (6) sites of stations, and
- (7) any other non-technical observations they may desire to make.

CHAPTER V.

CLASSIFICATION OF SURVEYS.

1. The necessary investigations preceding the actual commencement of construction of a railway are:—

(i) *Traffic Survey*.—This is a detailed study of the traffic conditions and prospects of an area with the object of determining the most promising route for a railway in the area, the probable traffic, and the standard of line suitable for carrying it.

(ii) *Reconnaissance Survey*.—This term is to be applied to all rough and rapid investigations of an area, or of one or more routes for a projected railway, from a general and somewhat hasty examination without instruments to a more careful investigation, involving, however, the use of only those instruments that will give approximate distances and heights rapidly, such as a prismatic compass, clinometer or hand level, range finder and similar instruments.

(iii) *Preliminary Survey*.—This is to consist in a detailed instrumental examination of the route or routes selected as a result of a "Reconnaissance" in order to obtain a close estimate of the probable cost of the projected railway: under this survey, however, the staking out of the alignment with a theodolite is not required. Whether a line is to be built or not will usually be decided on the results of this survey considered in conjunction with the Traffic Survey. The Railway Board may, however, require the submission of an estimate based on a Final Location Survey before sanctioning the commencement of construction.

(iv) *Final Location Survey*.—The principal difference between the work required in a Final Location Survey and that in a Preliminary Survey is that the alignment finally selected during a Final Location Survey must be fully staked on the ground with a theodolite or tachometer, the report must be fuller, and detailed plans and sections must be submitted. A Final Location Survey will not ordinarily be taken in hand until it has been decided that the line will be constructed.

CHAPTER VI.

TRAFFIC SURVEY.

1. *Field Work*.—This survey may be carried out independently or in conjunction with a Reconnaissance, Preliminary or Final Location Survey, and generally should, in the first instance, be so thorough as to render unnecessary any further traffic survey in connection with subsequent engineering surveys, if the latter are undertaken before conditions have changed.

2. An experienced commercial Traffic Officer should, as a rule, be entrusted with the work. He should be supplied by the Railway Administration with "terms of reference" containing instructions regarding the scope and nature of the investigation to be carried out, particulars of any railways already projected in the area, and what undertakings or interests, if any, are involved in the proposal. The terms of reference should also include instructions to the Officer in Charge of the Survey to visit the headquarters of the Main Line Administration at suitable intervals both during the progress of work in the field and during the period of recess in order to consult the Agent and his principal Officers, and where necessary have the original terms of reference modified from time to time. This is necessary in order that the Main Line Administration may fully determine the design of the new line under investigation.

3. He should work in close collaboration with the engineering survey party, if there is one in the field at the same time, and while collecting information should visit all trade centres in the area, and consult the local authorities and prominent citizens freely, both as regards trade and industry and the most suitable route for the railway.

4. The information thus obtained should be supplemented by the Traffic Officer's own observations. Particulars of Goods and Passengers using existing means of communication should, as far as possible, be checked by an actual 'census'. From the information collected, the Traffic Officer should estimate what traffic is expected on the line soon after opening, and should forecast, for the purpose of arriving at the financial prospects of the line, what the position will be as regards both the gross earnings and working expenses in the sixth year after opening.

5. The probable capital cost of the line must be obtained from the Engineer. If no engineering survey has been made, the capital cost of the line must be based on a cost per mile depending on the standard of construction to be adopted, deduced with as much accuracy as is possible. It should, in any case, be supported by an "Abstract Estimate" on Form N. L. 47, a detailed estimate of the cost of one mile of permanent way on Form N. L. 31, and an Abstract Estimate of the cost of the proposed junction arrangements. The basis of the figures, whether approximate or the result of a reconnaissance or preliminary survey, should be explained in the report.

6. *Report*.—The report should summarise the information obtained and conclusions arrived at, and should be sufficient to indicate the probable earnings of the proposed line (1) on opening, and (2) in the sixth year after opening to traffic, the most promising route or routes, and the standard of construction suited to the traffic expected. It should contain an explanation of how traffic on the new line is proposed to be worked, showing how this working will fit in with the services, present or proposed, on existing lines; and should give the proposed engine runs, method of working the passenger and goods stock, and amount of stock required.

7. The details of the information collected, calculations and diagrams, should be embodied in tables as annexures to the report.

8. A clear index map showing all relevant information should accompany the report: in particular, all towns and places referred to in the report should be clearly shown in the index map.

9. The form of the report will be governed largely by the nature of the proposal under investigation: under ordinary conditions, however, it should be framed under the following heads:—

- (1) History of the proposal, and "Terms of reference".
- (2) General description of country.

- (3) Alternative routes and possible extensions.
- (4) Location of route or routes examined.
- (5) Population, existing exports or imports.
- (6) Nature and volume of traffic on existing means of communication.
- (7) Possibilities of development of trade and industry.
- (8) Existing rates, and rates to be charged.
- (9) Station sites.
- (10) Train service necessary.
- (11) Coaching earnings.
- (12) Goods earnings.
- (13) Effect on existing lines, and interchanged traffic expected.
- (14) Standard of construction and probable capital cost.
- (15) Working expenses and net receipts.
- (16) Financial prospects of the proposal.
- (17) Conclusions and Recommendations.

10. *Annexures.*—The number and form of annexures to the report will vary according to the nature of the investigation, but in ordinary circumstances should include the information required in the standard forms N. L. 1 to N. L. 9 given at the end of this book. The details of information and arrangement of these forms may be altered where necessary to suit particular circumstances.

11. *Covering Note.*—The Traffic Report and Annexures should be accompanied by a covering note, which should have the authority of the Railway Administration submitting the project. It should state whether the estimates are accepted and, if not, explain what modifications are considered necessary.

12. It should conclude with the following summary, the figures in the Traffic Report being modified as proposed by the Railway Administration in the covering note. The figures of gross earnings and working expenses should be those estimated for in the sixth year after opening to traffic :—

- (a) Length of line.
- (b) Gauge.
- (c) Capital cost, including junction arrangements and interest on capital during construction.
- (d) Cost of line per mile, excluding junction arrangements and rolling stock.
- (e) Cost per mile of rolling stock, if provided.
- (f) Cost of junction arrangements.
- (g) Gross earnings of branch.
- (h) Gross earnings of branch per mile per week.
- (i) Gross earnings of branch per train mile.
- (j) Working expenses of branch.
- (k) Working expenses of branch per mile per week.
- (l) Working expenses of branch per train mile.
- (m) Working expenses of branch (including 5 per cent. of gross earnings on branch when rolling stock has not been provided under capital cost) . . . $(j + \frac{5}{100} g)$.
- (n) Gross earnings of existing lines from new traffic interchanged with the projected line.
- (o) Percentage of working expenses to gross earnings prevailing on connected existing lines.

- (p) Working expenses of existing lines for new traffic interchanged with the projected line.

$$n \times \frac{o}{100}$$

- (q) Net earnings on branch—

(g—j) where rolling stock has been provided for under capital cost.

(g—m) where rolling stock has not been provided for under capital cost.

- (r) Net earnings of existing lines from new traffic interchanged with the projected line (n—p).

- (s) Net income to be credited to projected line (q+r).

- (t) Percentage return on capital cost $(\frac{s}{c} \times 100)$.

13. *Arrangement of the Documents.*—The documents should be bound in the following order :—

1. Covering note.
2. Index.
3. Abstract estimate of cost of the line (Form N. L. 47).
4. Detailed cost of one mile of permanent-way (Form N. L. 31).
5. Report.
6. Annexures (including Forms N. L. 1 to N. L. 9).
7. Maps and diagrams.

CHAPTER VII.

RECONNAISSANCE SURVEY.

1. *Terms of Reference.*—The Railway Administration should supply the Engineer with "Terms of Reference" on the lines of that prescribed for a Traffic Survey, paragraph 2, Chapter VI.

2. *Field Work.*—In carrying out a Reconnaissance Survey, particular attention should be paid to ascertaining the amount of water-way required, and the best sites for stations, crossings of streams, ridges and roads. The nature of foundations for large bridges, and materials and labour available should be recorded.

3. Difficult country should be examined in sufficient detail to determine the ruling gradient and greatest degree of curvature desirable.

4. *Report.*—The report should, as far as possible, be on the lines of that prescribed for a Final Location Survey. It should contain a definite recommendation as to whether from the financial point of view the prospects of a line are such as to make it worth while to undertake further investigations with a view to the construction of the project.

5. *Estimate.*—The form of the estimate and the amount of detail to be contained in it will depend on the character and amount of the data collected, but an approximate abstract estimate of the cost of the line on Form N. L. 47 accompanied by an abstract estimate of the cost of Junction Arrangements and a detailed estimate of the cost of one mile of permanent-way (Form N. L. 31) are essential. The methods by which the figures in the Abstract Estimate have been deduced should be clearly explained in the report.

6. The report and estimates should be accompanied by a map of the area on a scale of 32 miles to the inch, and an index map on a scale of 4 miles to the inch, the proposed route or routes being marked on them in red, and all towns and places referred to in the report clearly shown therein.

7. The report, plans and estimates should be accompanied by a covering note as prescribed for a Traffic Survey (paragraphs 11, 12, Chapter VI).

CHAPTER VIII.

PRELIMINARY SURVEY.

1. *Terms of Reference.*—"Terms of Reference" should be supplied by the Railway Administration to the Engineer on the lines of that prescribed for a Traffic Survey, paragraph 2, Chapter VI.

2. *Field Work.*—The field work of a Preliminary Survey should include a compass traverse along one or more routes with such longitudinal and transverse levels as are sufficient to prepare a "predicted section" of the route or routes proposed.

3. The alignment need not be fully staked out with a theodolite, but stone pillars or other permanent marks should be left on the ground and indicated on the plans so that the location can be readily picked up by subsequent survey parties. Bench marks should similarly be left at intervals of about 2,000 feet.

4. In other respects the field work in a Preliminary Survey should approach the standards laid down for a Final Location Survey. It will depend largely on the nature of the country, and must always be sufficient to obtain a close estimate of the cost of the project.

5. *Report.*—The report should give details as in that prescribed for a Final Location Survey. Of the forms prescribed for tabulated details those for "Station Buildings", "Workshop and Store Buildings" and "Staff Quarters" need not be submitted with the report on a Preliminary Survey.

6. *Estimate.*—The rules laid down for the preparation of estimates of a Final Location Survey should be followed as closely as possible.

7. The method adopted of arriving at the figures of cost must be clearly explained in the report.

8. An estimate prepared on a Preliminary Survey should, under ordinary circumstances, be sufficiently accurate to enable the competent authority to decide whether sanction should be accorded to the construction of the line.

9. The Railway Board may in certain instances call for estimates on a Preliminary Survey to be submitted as prescribed for a Final Location Survey. When such estimates have not been called for, the estimates to be submitted on a Preliminary Survey will be those detailed in paragraph 4, Chapter I.

10. The report and estimates should be accompanied by the same maps as for a reconnaissance survey, and by an index plan and section on a scale of 1 mile to 1 inch horizontal and 100 feet to 1 inch vertical.

11. The detailed plans and sections and other drawings, as prescribed for a Final Location Survey, should be made out with as much detail as the information obtained in the field will allow, but need not be submitted with the report and estimates unless called for by the Railway Board.

12. The Report, plans and estimates should be accompanied by a covering note by the Railway Administration as prescribed for a Final Location Survey (paragraph 104, Chapter IX) and the documents should be bound in the order given in paragraph 105, Chapter IX.

CHAPTER IX.

FINAL LOCATION SURVEY.

1. *Terms of Reference.*—The Railway Administration should supply the Engineer with "Terms of Reference" on the lines of that prescribed for a Traffic Survey, paragraph 2, Chapter VI.

2. *Field Work.*—A Final Location Survey is to be based on a good theodolite or tachometer traverse, which should approximate as closely as possible to the centre line to be finally adopted.

3. Unless otherwise specified the survey operations must be sufficiently comprehensive to secure the information necessary for the preparation of the detailed plans and sections required under paragraphs 26–55 and having regard to all the circumstances of the case (including the probable working expenses) to ensure that the alignment selected is the most economical obtainable.

4. The amount of detail in sectioning will in great measure depend on the nature of the country traversed. Cross sections should be taken wherever the Engineer considers them necessary, and, generally, all information should be obtained that will enable a fairly accurate estimate to be prepared of the cost of the line.

5. Investigations should be made of Bunds, Bunded streams and Irrigation Works in the vicinity of the Projected Line which might affect the future safety of the line. Due regard should be paid to these works by the Engineer in making a decision on waterways and he should make an investigation as to the possibility of spending money on altering them as an alternative to incurring large expenditure on waterways.

6. In the case of a passage through hills, the geological characteristics of the country should be investigated by the Engineer, particularly in respect of the probable stability of the line, and if the importance of the work requires it, the Railway Administration should apply for the assistance of an officer of the Geological Survey of India.

7. *Notes to be made in the Field.*—During the survey, careful notes with dates should be made on the ground, from personal enquiry and observation regarding any information likely to be useful in working out the details of the project.

8. *The Centre Line.*—The unit of measurement is the chain of one hundred feet.

9. The centre line finally located is to be marked out by pegs at every 100 feet. At each 1,000 feet a large peg is to be used; these 1,000 feet pegs are to have their number branded or stamped on them in figures not less than one inch high. The numbers branded on the pegs are to indicate thousands of feet; thus 57 would mean a distance of 57,000 feet from the zero of chainage.

10. Masonry pillars should be built at the tangent points of curves and along the centre line at intervals of not less than 2,000 feet.

11. *Curves.*—Curves are to be defined both by their "degree of curvature" in degrees and minutes and by their radius in feet. The degree of curvature is to be taken as the angle at the centre subtended by an arc of one hundred feet in length. The radius of a 1° curve is 5,729.578, say 5,730 feet; the radius of other curves may be formed by dividing 5,730 by the degree of curvature.

12. The apex angle formed by the intersections of the tangents should, if practicable, be observed; if not, it should be calculated.

13. Large pegs, distinguished in some suitable manner from the 1,000 feet pegs, should be put in on the straight at the calculated tangent length from the apex and also at the offset distance (see paragraphs 14, 15) measured at right angles to the tangent at this point, from which, as a rule, the circular part of the curve is laid out.

14. *Transition Curves.*—Changes of curvature (whether at the junction of a straight line with a curve or in the middle of a compound curve) should be effected by means of "transition curves". This entails the "offsetting" or "shifting" inwards of circular curves pegged out primarily with a theodolite from the tangent point mentioned in paragraph 13.

15. The amount of shift depends on the length of transition curve, which length usually depends on the amount of cant and the distance in which it is run out.

16. *Gradients.*—Gradients are to be defined by the distance in which a rise or fall of one foot occurs and by their rise or fall in feet per standard chain of 100 feet. Thus a rising gradient of six inches in a hundred feet is to be described as "Rise 1 in 200 (0.5 per cent.)."

17. All railways should be graded with due regard to the possibility of additional intermediate stations being constructed later on.

18. Sharp changes of gradient should be avoided, if possible, on curves.

19. All sharp changes of gradient should be eased off by vertical curves.

20. *Compensation for Curves on Gradients.*—All gradients must be compensated for curvature if the ruling gradient would otherwise be exceeded. The compensation to be allowed should ordinarily be 0.04 per cent. per degree of curvature on the 5 feet 6 inches gauge, 0.03 per cent. per degree on the metre gauge, 0.02 per cent. on the 2 feet 6 inches gauge, and 0.015 per cent. on the 2 feet gauge. Compensation should be allowed on easy curves as well as on sharp ones.

21. *Bench Marks.*—Bench marks should be left at intervals of not more than half a mile along the line and at sites of important bridges. In every case the position chosen for a bench mark should be such that it can be conveniently referred to during construction and is, at the same time, not liable to be interfered with during the progress of construction.

22. Bench marks must be of such character or construction as not to be readily moved or injured by accident or mischief. All bench marks should be so placed and marked as to be easily identified and their correct description and location should be recorded.

23. *Datum for Levels.* The datum to which all levels are to be referred is the Mean Sea Level as adopted for the Great Trigonometrical Survey of India. During the progress of the survey and location of the line every opportunity should be taken to connect the levels with any Survey of India level stations in the neighbourhood, and to check the difference between any temporary datum and mean sea level.

24. *Compass Bearings.* The compass bearing of each tangent should be taken at every curve in level country, and the mean of the readings at the two ends should be recorded as the average bearing for each straight line.

25. In hilly country where curves are frequent, it will be sufficient to take such bearings at about 3 or 4 places in each mile.

26. *Plans, Sections and Designs for Works.*—A set of plans and sections for a project is to consist of:

(i) General Map of the country traversed by the project, scale about 32 miles to 1 inch.

(ii) Index Map, scale about 4 miles to 1 inch.

(iii) Index Plan and Section.

(iv) Detailed Plans and Sections.

(v) Plans and Cross Sections of Rivers.

(vi) Plans of Station Yards.

(vii) Detailed Drawings of Structures.

(viii) Plans of Junction Arrangements.

27. The Index Plan and Section must be on tracing cloth. The other plans and sections may be either on tracing cloth or reproduced by the Ferro-gallic process on "Photographic Black Line Linen". The size of each sheet is to be 48 inches by 36* inches. The sheets are to be fastened together along their left-hand

* As exceptions to this rule, Index Plans and Sections and Plans of Stations may be longer than 48 inches, if necessary, to enable all the information to be shown on one sheet. In such cases, however, the width of 36 inches must still be kept to, and the length in excess (which, however, should not exceed 40 inches) must be M&TO

edges, and bound between limp covers so as to allow the set to be easily rolled up. Interleaving with either cloth or paper is not desired. The maps and drawings should be bound up in the order given. The General and Index Maps should be Survey of India Maps,* if obtainable, or compiled from them, and the sheets should be of the size prescribed above. On the Index Maps metalled roads should be shown pink, unmetalled roads yellow and canals, rivers, and lakes, blue. Care should be taken that the name and position of every place mentioned in the Report is shown on the maps and plans.

28. Throughout each set of plans and sections, the mileage is to be reckoned from the same Fixed Point. This fixed point should, if practicable, be at that end which is in the direction of the nearest seaport with which the line is in through communication by rail, and is to be clearly defined on the Index Plan and Section, and on at least the first and last sheets of the Detailed Plans and Sections. If the line takes off from an existing railway station, the zero point should be fixed at the centre of the existing station yard, and when it ends at an existing station the end of the survey should be taken as the centre of that station. Each sheet should be plotted in the direction of the through mileage so that the mileage may be read from left to right.

29. The datum used for all plans and sections is to be Mean Sea Level, and all heights are to be referred to this datum in feet and decimals. Should any other datum have been adopted for temporary use during the progress of the survey, the figures referring to such temporary datum must be reduced to Mean Sea Level before being entered on the plans and sections.

30. On each sheet is to be noted a reference number or letter, the name of the railway or section of railway, the gauge and the scale. The scale may be described in words, and need not be drawn. The magnetic north is to be indicated on each map and plan by a line not less than six inches in length.

31. The Index Plan and Sections, and the first and last sheets of the set of Detailed Plans and Sections are to be signed and dated by the Engineer. Every sheet should be signed and dated by the officer responsible for the preparation of it.

32. *Index Plan and Section.*—The Index Plan and Section are to be drawn to a scale of 1 mile to 1 inch horizontal and 100 feet to 1 inch vertical, the plan above the section on the same sheet.

33. *The Index Plan.*—On the Index Plan are to be shown all towns, roads, canals, rivers, hills, boundaries of provinces or districts and Native States within a distance of 5 miles on each side of the railway. The centre line of the proposed railway is to be indicated by a full red line one thirty-second of an inch in thickness. The degree and radius of all curves should be figured. The position of each station is to be shown by a red block, the name of the station being given. The mileage from the "fixed point" is to be marked and figured at every mile, and the extent of each sheet of the detailed plan shown. Where practicable, the index plan should be traced from the sheets of the Survey of India map published to a scale of 1 mile to 1 inch, the details in the immediate neighbourhood of the railway being filled in or corrected if necessary from the information given by the railway survey. For districts where a map to the scale of 1 mile to 1 inch is not available, the information required should be plotted to that scale from such other maps or data as can be obtained.

34. *The Index Section.* The Index Section should show the formation level by a red line; the gradients are to be figured, and height of formation above mean sea level to be entered at each change of gradient. The position of each important bridge with name of river and number and size of bridge spans should be indicated; also level crossings with their classification as 1st, 2nd or 3rd class and position of each station with its name and distance from the "fixed point". The mileage from the "fixed point" is to be marked and figured at every mile.

35. *Detailed Plans and Sections.*—The detailed plans and sections are to be drawn to a scale of 400 feet to 1 inch horizontal, and 40 feet to 1 inch vertical, the plan in each case to be above the section on the same sheet. Three miles of line should be illustrated on each sheet, and the divisions between the sheets in

* A catalogue of maps published by the Survey of India is obtainable from the Manager, Central Publication Branch, 8, Hastings Street, Calcutta.

each case are to be a mile-mark. To admit of the sheets being readily connected, each sheet should have a skeleton outline for a few hundred feet beyond the mile-mark at each end repeated from the adjoining sheets on both the plan and section. In difficult or mountainous country, if the Engineer considers it necessary, the plan should be made on a larger scale such as 200 or 100 feet to an inch.

36. *The Plan.*—On the plan should be shown in detail all features of the country within a distance of three hundred feet on each side of the centre line of railway showing clearly the boundaries of village lands. The boundaries of different kinds of cultivation, forest, pasture, waste, etc., should also be marked on the plan. The centre line of the proposed railway should be indicated by a full red line one thirty-second of an inch in thickness. The position of all masonry centre-line pillars and the exact position and description of each bench-mark is to be shown.

37. In addition to the foregoing, the following details are to be shown, in so far as they lie within a distance of 1,000 feet on either side of the centre line:—

Rivers requiring a waterway of 40 lineal feet or upwards.

Important roads with their bridges, culverts, mile-marks, and fractional mile-marks.

Canals and large tanks, Bunds, Bunded-streams and Irrigation works.

The outlines of all towns and villages and, in the case of large towns, the important streets and thoroughfares.

The boundaries of Provinces, Local Administrations, Native States, Divisions and Districts.

Hill peaks and other important features of the country.

Great Trigonometrical Survey Stations.

Camping grounds, rifle ranges, etc.

38. Care should be taken to give sufficient topographical details to exhibit the contour of the ground and to justify the alignment selected.

39. All new works proposed for the purposes of the railway or for the accommodation of the public are to be marked on the plan, also all alterations, diversions, protection works, etc., proposed in connection with existing railways, roads, rivers, canals, or tanks. The "pattern for detailed plan" given at the end of this book should be followed.

40. In the case of a junction with an existing railway, the plan must show the existing line for not less than one mile on each side of the proposed junction, the proposed junction arrangements, and the position of all buildings, bridges, level crossings, mile posts and other works on, or belonging to, the existing railway; the springing points of curves on the existing railway are to be marked and the angle of curvature noted.

41. *The Section.*—On the section, the formation level is to be shown by a red line, the ground line being black. If practicable, throughout each sheet, the ground line and formation should be continuous, i.e., without "steps" or changes of datum; for long lengths of steep ruling gradients it is advisable to incline and "step" the datum line.

42. Two sets of heights or levels are to be given, viz., (1) Height of ground above Mean Sea Level, and (2) Height of formation above Mean Sea Level. The first set of figures showing ground-level are to be the lowest in position, i.e., nearest the bottom of the sheet. The height or levels are to be given in feet to one place of decimals, and are to be entered at every 100 feet,* vertical ordinates being ruled up to connect the figures with the ground line. These vertical lines to be in blue, except where they occur at a change of gradient where they will be red. See the "pattern for detailed section" at the end of this book.

43. The bed level and high flood level of all rivers and streams should be shown, also the position, description and level (to 2 places of decimals) of all bench-marks, and position of all masonry pillars.

44. Gradients are to be entered in a plain and conspicuous manner. At each change of gradient an ordinate is to be drawn in red up to formation level,

* For a set of tracings submitted to the Railway Board, it will suffice if heights or levels are entered at every 1,000 feet instead of at every 100 feet.

and the height of formation noted to two places of decimals. Where a change of gradient occurs at any point other than one of the 100 feet marks, the chainage of the changing point is to be noted.

45. In addition to the above the following should be shown: the tangent points of all curves, the mileage and chainage, the general description of the soil, the position of all bridges, level crossings, etc., where roads or waterways are diverted this should be noted.

46. Tunnels are to be drawn to scale on the section, and the length in feet is to be noted in each case.

47. A station is to be indicated by a vertical red line at each end drawn upwards from formation level to define the limits of the station yard. The name of the station and the length in feet of the station yard are to be noted.

48. Where cross sections have been taken, a reference to each should be given on the main section with a vertical line indicating the position. Cross sections may be plotted to a natural scale, both the vertical and horizontal scales being the same as the vertical scale used for the main section (*i.e.*, 40 feet to 1 inch), and on each cross section the outline of the cutting or embankment should be correctly shown. For many practical purposes it will, however, be possible to give all the information required from cross sections by contour lines on the detailed plans.

49. Cuttings should be graded with special reference to efficient drainage.

50. *Plans and Cross Sections of Rivers.* For each river requiring a provision of waterway of 1,200 square feet or upwards, the following particulars are to be given, subject to the proviso that the Engineer may exercise his discretion as to the necessity for these plans and sections in mountainous country:

(a) *Plan.*—A plan to a scale of 400 feet to 1 inch of such portion of the river and its affluents as may lie within a distance of not less than one mile from the proposed centre line of railway, measured from any point on that centre line, or such further distance as the Engineer may consider necessary. On the plan are to be shown by red lines the positions of cross sections taken of the river, with references: the centre line of railway with miles and 1,000 feet chainage distance marked and figured; the position of two abutments of the proposed bridge marked on the railway centre line and the position and extent of any protection or training works proposed with such notes as the Engineer may consider necessary. The direction of the current should be indicated by arrows.

(b) *Cross Sections.*—Three cross sections of the river bed are required, plotted to a natural scale of 40 feet to 1 inch. Where the width of the river in flood exceeds 3,000 feet, this scale may be reduced. With a width from 1,500 to 3,000 feet the cross sections should be plotted in two halves. The cross sections are to be taken at typical points selected at intervals of about a mile measured along the centre of river bed. On each cross section lines are to be drawn to indicate the level of highest known flood, ordinary flood, and ordinary low water, with the reduced level figured on each. On the cross section taken on the centre line of railway an elevation of the proposed bridge is to be drawn to scale in its proper position. The chainage is also to be figured on the cross section. Where borings or trial pits have been sunk, their position, with a note on results, should also be given. The cross sections may be plotted on the same sheet as the plan, or on separate sheets as may be found convenient in each case.

51. *Plans of Station Yards.*—For stations requiring a special design, a plan of the station yard to a scale of 100 feet to 1 inch is required, showing all lines, sidings, platforms, buildings, wells, tanks, water-cranes, ash-pits, turn-tables, traversers, weigh-bridges, signals, etc., within the boundary of the station yard; also any roads, buildings, etc., lying outside the station yard but immediately adjacent thereto. The name of each work or structure must be entered against

it on the plan, with such notes and dimensions as may be necessary to define its size, position and purpose for which intended.

52. For other stations, made according to type designs, a plan giving similar information is required for each different type or arrangement adopted. On each type plan should be noted the names of the stations which are to be laid out in general accordance with that plan, with a description of any important variations adopted at one or more of those stations.

53. In designing the station yards the open line Administration should be consulted and full provision should be made for extensions for future developments of traffic, but nothing should be estimated for which is not absolutely essential for dealing with the traffic expected in the first five years of working, everything in excess of this being shown in dotted lines and left to be added when actually required.

54. *Plans of Junction Arrangements.*—Plans of Junction Stations of 100 feet to 1 inch similar to the plans prescribed in paragraph 51 for Station Yards are required, showing clearly in full red lines the proposed works necessary to deal with the traffic expected during the first five years of working, and in dotted red lines the provision made for future development of traffic.

55. Except where the new line is of a different gauge and has entirely its own arrangements, the plans for the junction arrangements should as a rule be prepared by the open line Administration in consultation with the Engineer.

56. *Detailed Drawings of Structures, etc.*—Though many of them are not required for submission to the Railway Board with a construction estimate, it will be necessary for numerous detailed drawings to be prepared in order that sufficiently accurate estimates can be compiled. These must be carefully recorded for future use.

57. The drawings which are usually required by the Railway Board are as follows:—

Type drawings of banks, cuttings and tunnels in cases only where the proposals differ from the prescribed maximum and minimum dimensions.

Skeleton outline drawings to small scale of all large bridges.

58. *Report and Appendices.*—The Report should be divided into chapters as follows:—

- (1) History and Geography.
- (2) Gauge, Length, Fixed Point, Levels, Gradients and Curves.
- (3) Location.
- (4) Alternative Routes and possible extensions.
- (5) Relations with the public and with the Military and other Government departments.
- (6) Construction and Engineering.
- (7) Conclusions and Recommendations.

59. (1) *History and Geography.*—The first chapter should begin with reference to orders of Government and a brief statement regarding the object of the projected Railway.

60. This should be followed by a general description of the country to be traversed, prominence being given to the physical, geological and botanical features of the country in so far as these are likely to affect the alignment, probable stability of the line, cost of construction, working expenses or future prospects of the railway.

61. Then the history of the project should be given. Reference should be made to previous reports or other sources of information on the subject, giving when practicable the substance of such documents so that the report may be complete in itself and render a reference to the previous papers unnecessary. Whenever it appears desirable to quote long extracts from the previous papers it will generally be advisable to relegate them to an appendix.

62. The history of the project should be brought up-to-date by a description of the scope of the survey on which the report is based and of the work accomplished during the field season. The organisation adopted for the survey parties, the work done by them and their progress with dates should be given in a brief narrative form.

63. (2) *Gauge, Length, Fixed Point, Levels, Gradients and Curves*.—The second chapter of the report may conveniently be divided into six sections.

64. *Gauge*.—The gauge adopted for the projected railway should be stated, also the reasons for adopting it.

65. *Fixed Point*.—The "fixed point" or zero from which the mileage of the projected railway is reckoned should be clearly defined.

66. *Length of Line*.—The total length of the projected railway should be mentioned, also the length in every Presidency, Province, Native State, Division and District and the length of the sections into which the projected railway has been divided for estimating purposes.

67. *Datum for Levels*.—Sometimes there is a discrepancy between the values of bench marks used by various departments of Government or by railways in the neighbourhood from which a projected railway starts: any discrepancy of this sort, and any errors in levels which are known to exist along the line of the projected railway, should be mentioned.

68. *Gradients*.—The ruling gradient in each engine-run of the projected railway should be stated and reasons given for its adoption. Calculations regarding the most economical ruling gradients may be relegated to an Appendix.

69. The following points require notice:—

Sharpest curves in each engine-run with reasons for adoption; minimum distance between reverse curves; formula used and method adopted for laying out Transition Curves and Vertical Curves.

70. (3) *Location*.—This chapter should be divided into sections corresponding to the sections into which the projected railway has been divided for estimating purposes.

71. The following are some of the subjects to be dealt with:—

General description of the location; obligatory points; minor deviations from the projected alignment rejected or recommended for further examination; selection of junction and other station sites and work proposed at those sites; short description of river crossings and other important works.

72. In the case of a large railway project, detailed reports should be written by the various Executive Engineers regarding the Location of their respective divisions. These reports should be printed in an Appendix to the Engineer's Report which should deal fairly briefly with the General Location of the line.

73. Calculations regarding the cost of "Distance," "Curvature" and "Rise" and "Fall" should be relegated to an appendix, but references to these calculations should be made where necessary in discussing minor deviations from the projected alignment.

74. (4) *Alternative Routes and possible Extensions*.—*Alternative Routes*.—This chapter should deal with alternative routes several miles in length rather than with minor deviations from the projected alignment which should be discussed in the chapter on Location.

The advantages and disadvantages of each alternative route should be clearly explained and reasons should be given why the alignment finally selected is preferred.

75. In dealing with this subject, calculations should be taken out regarding the most economical ruling gradient and regarding the 'minor details of alignment.'

76. *Extensions*.—At the time when he is writing his report, the Engineer should have a much better idea than anyone else about the branches and other extensions of his projected railway which are likely to be needed in the near or

the distant, future; he should record his opinions on the subject, even if he has received no definite instructions to that effect.

77. (5) *Relations with the Public and with the Military and other Government Departments*.—This chapter of the report should deal with subjects of the following nature:—

Cases in which the proposed railway works would interfere with existing military cantonments, buildings, rifle ranges, camping grounds or communications. Extent of such interference, opinion of local military authorities and how their objections, if any, can best be met. Adaption of bridges to take heavy lorries, guns and other military traffic.

78. (6) *Construction and Engineering*.—This chapter should commence with a statement of the "Standard of Construction" of the Projected Railway, comparing the projected line with similar railways already in existence and justifying the proposed standard by a reference to the anticipated traffic.

79. Following the general statement there should be notes on each of the main heads of the estimate describing the standards of the works for which the estimate provides.

80. Following these notes on the estimate, an abstract should be given of the notes collected in the field and elsewhere regarding (a) Labour, (b) Materials, (c) Transport, and (d) Rates for construction work.

81. An analysis of the principal rates adopted in the estimates and reasons for adopting them should be given in an appendix.

82. The following are some of the points which require mention in the notes on heads of the estimate:—

83. *Preliminary Expenses*.—Cost of surveys already carried out and of future survey operations which will be required before the projected railway can be constructed.

84. *Land*.—Width of land for which the estimates provide, particularly whether provision is made for doubling the line or not; difficulties which may be expected in acquiring land owing to existing buildings, religious prejudices, military rights or other special causes. Data regarding cost of land, obtained from the civil authorities, should be relegated to the appendix on "Rates".

85. *Formation*.—Formation width on banks and in cuttings; side-slopes of banks and cuttings; provision for turfing or other protection for banks and cuttings and for repairing them and for topping banks with selected material; sections of tunnels, retaining walls, side-drains and catch-water drains.

86. *Bridgework*.—Number of lineal feet of waterway per mile, that for Major and Minor Bridges being given separately (a bridge which has a total waterway of 60 lineal feet, or more, or which has a clear opening of 40 lineal feet, or more, in any one span is classed as a Major Bridge).

Descriptions of individual important bridges, (a bridge with a total waterway of 600 lineal feet or 1,200 square feet, or more, should be classed as an important bridge) and of designs adopted for other bridges, noting any difficulties expected, special methods proposed for construction, material to be used and other particulars.

87. For girders or other steelwork an analysis of the rate per span and per ton is necessary; this should be given either in the body of the report or in the appendix on rates.

88. *Fencing*.—Description of fencing; whether the line will be completely fenced or, if not, where fencing is to be erected.

89. Notes on position and type of Road Crossings and Road Diversions.

90. *Electric Telegraph*.—Notes regarding any permanent cable over a river which it is not intended to bridge in the immediate future, and regarding any telephones or other electric instruments for which provision is made in the estimate.

91. *Ballast and Permanent-way.* Ballast, nature of ballast, sources of supply and number of cubics allowed per foot run.

92. *Sleepers.* Description of sleepers recommended with reference to their durability, cheapness, or other advantages : size of sleepers and number per mile.

93. *Rails and Fastenings.* Weight of rail recommended with reference to expected traffic : type of permanent-way adopted for estimating purposes, with reasons for adoption.

94. *Stations and Buildings.* Descriptions of stations and buildings if there is anything worth notice which has not already been dealt with under "Location," height, length and width of platforms, location of administrative and other offices.

95. Position selected for Locomotive, Engineering and Carriage and Wagon Workshops : extent of these shops : what work, if any, is to be done by the workshops of the parent line or of neighbouring railways.

96. *Staff Quarters (Permanent).* Provision made in the estimate, with description of types of quarters, dispensaries, institutes, etc., headquarters proposed for Divisional or District Officers, etc., existing accommodation available for railway staff in cantonments, civil stations, etc.

97. Engine-changing arrangements, length of each engine run, water-supply for running sheds, watering stations, workshops and staff quarters, signalling and interlocking arrangements. A full explanation of how the traffic on the new line is proposed to be worked, as required in the Corrigendum to paragraph 6 of Chapter VI, on the Traffic Survey, should also be included if this information has not been given in a Traffic Survey accompanying the Report.

98. *Ferries.* If there are any ferries or floating bridges on the projected railway, notes on the provision made in the estimate will be required.

99. *Plant Construction.* Notes on expensive plant for important construction works and on the final allocation of the cost of such plant.

100. *Rolling Stock.* Notes on whether rolling stock has been provided for or not. If provided for, the number and type of engines and other rolling stock and reasons for the provision made.

101. *General Charges.* Agency by which the projected railway is to be constructed. Headquarters proposed for Engineer-in-Chief and other construction officers. Division of the Railway for construction purposes. Sanitary conditions as affecting location of staff and necessary medical establishment. Offices and quarters for construction staff and huts for workmen, if required.

102. *Cost of Construction.*— Chapter (6) should conclude with a statement of the estimated cost of constructing the projected railway, and that of the junction arrangements.

Tabulated Details.

103. The Report should be accompanied by the following "Tabulated Details" :—

- (i) Stations and Station Sites.
- (ii) Curve Abstract.
- (iii) Gradient Abstract.
- (iv) Bridge Abstract.
- (v) Important Bridges.
- (vi) Fixed Station Machinery.
- (vii) Station Buildings.
- (viii) Workshops and Store Buildings.
- (ix) Staff quarters.

Covering Note.

104. A covering note by the Railway Administration, on the lines of that prescribed for a Traffic Survey in paragraph 11, Chapter VI, should accompany the Project Report and Annexures. If any estimate has been submitted previously for the project, a comparison should be made between the estimate under consideration and that already submitted to or sanctioned by the Railway Board. An explanation should also be given in the note of any material modification made in the project or excess in the estimate over an existing sanctioned estimate, and the summary detailed in paragraph 12, Chapter VI, should be given with the figures modified to agree with those in the project report and estimates under consideration.

Arrangement of Documents.

105. The documents should be bound in the following order :—

- 1. Covering Note.
- 2. Index.
- 3. Report, followed by a "List of Drawings accompanying the Report."
- 4. Appendices to the Report—
 - (a) Historical and Geographical.
 - (b) Location Reports.
 - (c) Rates for construction work.
- 5. Tabulated details (Forms N. L. 10 to N. L. 15).
- 6. Detailed estimates on the standard forms (N. L. 16 to N. L. 47).
- 7. Abstract estimate of junction arrangements.
- 8. Index map and General map.

CHAPTER X.

CONSTRUCTION ESTIMATE.

A construction estimate must be based on a Final Location Survey. It should be prepared in such detail as to render it possible to dispense with working estimates or any other further estimating after the construction estimate has been sanctioned (except when supplementary or revised estimates are necessary) and to ensure that all details have been so carefully examined before construction commences that subsequent revision of the estimate shall be very rarely necessary.

2. *Division of Estimates into Sections.*—The principles according to which an estimate should be divided into sections are as follows :—

- (a) When, as is usually the case, certain works within the limits of a junction station are incidental to the project, these works should form a distinct section.
- (b) When a project comprises a "main line" and a "branch," the branch should form at least one distinct section.
- (c) Where the country traversed by a line is such that it may readily be divided into tracts of distinctive topographical character, the length through each class of country may comprise a section, or a project may be divided into "engine runs" or into lengths suitable for "construction divisions."
- (d) Where there is a likelihood of different sections of a project being opened to traffic at different intervals, the estimate for each such section should be kept distinct.
- (e) When an estimate for any alternative alignment of importance is included, the estimate for the alternative alignment and for the length which it would supersede, if adopted, should each be comprised in a distinct section.

3. The provision made for each section must be divided among the various main heads, sub-heads, and detailed heads of account prescribed in paragraph 5.

4. Except where the new line is of a different gauge and has entirely its own arrangements, the estimate for the junction arrangements should be obtained from the open line Administration of the connecting system, and a separate Abstract Estimate of the cost of the additions and alterations necessary for effecting the junction should be submitted with the Construction Estimate.

5. *Main Heads and Sub and Detailed Heads of Railway Estimates.*—The construction expenditure of a railway is to be classified under the following Detailed Heads of Account :—

Main Heads.	Sub and Detailed Heads.
I.—Structural Engineering Works.	(1) Preliminary Expenses :— (a) Survey Expenses. (b) Plant. (c) Establishment. (2) Land. (3) Formation : (a) Earthwork. (b) Tunnels. (c) Walling. (d) Side drains.

Main Heads.	Sub and Detailed Heads.
I.—Structural Engineering Works— <i>contd.</i>	(4) Bridgework :— (a) Major Bridges— (i) Steel work. (ii) Masonry. (iii) Miscellaneous. (b) Minor Bridges— (i) Steel work. (ii) Masonry. (iii) Miscellaneous. (5) Fencing :— (a) Fencing. (b) Road crossings. (c) Mile and Gradient posts. (6) Electric Telegraph. (7) Ballast and permanent-way :— (a) Main Line— (i) Rails and Fastenings. (ii) Sleepers and Fastenings :— (a) Sleepers— (1) Wood. (2) Cast iron and ferroconcrete. (3) Steel trough. (b) Fastenings. (iii) Ballast. (b) Sidings :— (i) Rails and Fastenings. (ii) Sleepers and Fastenings :— (a) Sleepers— (1) Wood. (2) Cast iron and ferroconcrete.

Main Heads.	Sub and Detailed Heads.
I.—Structural Engineering Works— <i>concl.</i>	(3) Steel trough. (b) Fastenings. (iii) Ballast. (c) Electric Track Equipment. (d) Points and Crossings— (i) Points and Crossings. (ii) Crossing sleepers and Fastenings (a) Sleepers— (1) Wood. (b) Fastenings. (8) Stations and Buildings :— (a) Stations and Offices— (i) Masonry buildings. (ii) All others. (b) Workshops, Store buildings, etc.— (i) Masonry buildings. (ii) All others. (c) Electric Power Stations and Sub-Station buildings— (i) Masonry buildings. (ii) All others. (d) Residential buildings— (i) Masonry buildings. (ii) All others. (e) Fixed Station Machinery. (9) Shore connections for Ferry Steamers. (10) Plant—Construction. (1) Plant :— (a) Engineering. (b) Locomotive. (c) Carriage and Wagon. (d) Electric Traction Power Station and Sub-Stations. (e) Electric. (f) Miscellaneous.
II.—Equipment	

Main Heads.	Sub and Detailed Heads.
II.—Equipment— <i>contd.</i>	(2) Station and Office furniture. (3) Motors, Lorries. (4) Steamers or Boats required for the general purposes of the railway but not for public traffic.
III.—Rolling Stock	(1) Rail :— (a) Locomotives— (i) Engines and Tenders. (ii) Boilers. (iii) Electric. (b) Carriage and Wagon— (i) Coaching vehicles. (ii) Goods vehicles. (c) Motor vehicles. (2) Motor vehicles—Road. (3) Ferries— (a) Steam Boats. (b) Barges and Minor Craft.
IV. General Charges	(1) Salaries and Allowances :— (a) Direction and General. (b) Engineering. (c) Audit and Accounts. (d) Stores. (e) Medical and Sanitation. (2) Office expenses— (a) Accommodation. (b) Contingencies. (3) Residential quarters. (4) Instruments. (5) General Charges on Stores— (a) Indian Freight and Handling. (b) Miscellaneous Indian charges.
V.—Collieries	(1) Colliery Block Account. (2) Plant and Equipment. (3) Sinking Fund.
VI.—Miscellaneous	

6. Paragraph 35 of the State Railway Code for the Engineering Department will give details of the charges to be comprised under each of the heads named in the preceding paragraph.

- **TRAFFIC SURVEY.**
STANDARD FORMS.
(N. L. 1 TO N. L. 9.)

Railway.

Gauge.

Miles.

PARTICULARS OF POPULATION.

Station.	Villages served.	Population.	Area Sq. Miles.	Density per Sq. Miles.	Remarks.

Railway.

Gauge.

Miles.

Length.

PARTICULARS OF CULTIVATION.

Station.	Corps.				Total.	Remarks.
	Acres.	Acres.	Acres.	Acres.		
• Total ..						

SURPLUS PRODUCTS.

Station.	Maundage of crops.	Consumption at mds. per head per annum.	Surplus products.	Remarks.
	Mds.			
Total ..				

N. L. 3.

Railway.

Gauge.

Length.

Miles.

IMPORTS AND EXPORTS.

Imports.

Station.	Commodity.				Total.	Remarks.
	Mds.	Mds.	Mds.	Mds.		
Total ..						

Exports.

Station.	Commodity.				Total.	Remarks.
	Mds.	Mds.	Mds.	Mds.		
Total ..						

N. L. 4.

Railway.

Gauge.

Miles.

Length.

COMPARISON OF RATES.

Passenger.

Stages.		Existing modes of conveyance.			Proposed. Railway.	Remarks.
From	To					

Goods.

Stages.		Existing modes of conveyance.			Proposed Railway.	Remarks.
From	To					

Railway.

Gauge.

Length.

Miles.

TIME TABLE.

Up.

Distance.	Inter- mediate distance.	Station.	Proposed Train Service.			Remarks.
			H. M.	H. M.	H. M.	
		Speed ..				

Down.

Distance.	Inter- mediate distance.	Station.	Proposed Train Service.			Remarks.
			H. M.	H. M.	H. M.	
		Speed ..				

Railway.

Gauge.

Miles.

Length.

ESTIMATED GROSS EARNINGS OF BRANCH.

In sixth year after opening.

Coaching.

Class.	Estimated amount.	Per Passenger train mile.	Remarks.
III Class Traffic			
Upper Class Traffic			
Other Coaching Traffic			
Total Coaching Earnings ..			

Goods.

Station.	Weight.	Average lead on Branch.	Maund miles.	Rate per maund mile.	Amount.	Remarks.
Exports :—					Rs.	
Total earnings on Exports.						
Imports :—						
Total earnings on Imports.						
Total goods earnings.						
Gross earnings of Branch						

Do. do. Per miles per week.

Do. do. Per train mile.

N. L. 7.

Railway.

Gauge.

Length. Miles.

ESTIMATED GROSS EARNINGS OF EXISTING LINES.

From new Traffic interchanged with projected Railway.
in the sixth year after opening to Traffic.

Coaching.

Class.	Number.	Average Lead on existing lines.	Rate per mile.	Amount.	Remarks.
III class traffic ..	..			Rs.	
Upper class traffic ..	..				
Other coaching traffic ..	..				
Total coaching					

Goods.

Station.	Weight.	Average lead on existing lines.	Maund. miles.	Rate per Maund.	Amount.	Remarks.
Exports :—	Mds.	Miles.			Rs.	
Total earnings on Exports.						
Imports :—						
Total earnings on Imports :						
Total goods earnings :						
Gross earnings of existing lines :						

N. L. 8.

Railway.

Gauge.

ESTIMATE OF WORKING EXPENSES OF BRANCH.

In the sixth year after opening.

Length. Miles.

TABLE "A".

Maintenance of structural works.

Reference to Accounts.		Details.	Total amount.	Per train mile.	Per mile of line main- tained.	Percentage of total Expendi- ture under Abstract "A".
Abstract and minor head.	Sub- head.					
A. I.		General Administration				
	II	Ordinary Repairs and Maintenance—				
	1	Structural Works—				
		(a) Track (Running lines, sidings and yards)				
		(b) Bridges and Tunnels				
		(c) Miscellaneous				
	2	Equipment				
	3—6	Miscellaneous				
		Total Ordinary Repairs and Main- tenance				
	IV	Replacement and Renewal—				
	1	Structural Works—				
		(a) Track (Running lines, sidings and yards)				
		(b) Bridges and Tunnels				
		(c) Miscellaneous				
	2	Equipment—				
		Total Replacement and Renewal				
		Total Maintenance of Structural Works				

N. L. S.

Railway.

Gauge.

Length. Miles.

TABLE "B".

Maintenance and Supply of Locomotive Power.

Reference to Accounts.		Details.	Total amount.	Per train mile.	Per engine mile.	Percentage of total Expenditure under Abstract "B".
Abstract and minor head.	Sub-head.					
II		General Administration				
		Ordinary Repairs and Maintenance—				
	1	Locomotives—				
		(a) Running repairs				
		(b) Workshop repairs				
	3	Equipment				
III		Total Ordinary Repairs and Maintenance				
		Operating Expenses—				
	1	Running Staff				
	2	Fuel				
	3—4	Water, oil, tallow and stores ..				
	7	Miscellaneous Expenses				
IV		Total Operating Expenses ..				
		Replacement and Renewal—				
	1	Locomotives				
	4	Equipment				
		Total Replacement and Renewal ..				
		Total Maintenance and Supply of Locomotive Power				

N. L.

Railway.

Gauge.

Length Mile.

TABLE "C."

Maintenance of Carriage and Wagon Stock.

Reference to Accounts.		Details.	Total Amount.	Per train mile.	Per 1,000 vehicle miles.	Percentage of total Expenditure
Abstract and minor head.	Sub-head.					
C. I		General Administration				
		Ordinary Repairs and Maintenance—				
	1	Coaching vehicles				
	2	Goods vehicles				
	4	Equipment				
		Total Ordinary Repairs and Maintenance				
III		Operating Expenses				
		Replacement and Renewal—				
	1	Coaching vehicles				
	2	Goods vehicles				
	3	Equipment				
		Total Replacement and Renewal ..				
IV		Total Maintenance of Carriage and Wagon stock				

TABLE "D."

Maintenance of Ferry Steamers and Harbours. (This is seldom required, where required full details should be given.)

N. L. S.

Railway.

Gauge.

Length.

Miles.

TABLE "E."

Expenses of Traffic Department.

Reference to Accounts.		Details.	Total amount.	Per train mile.	Percentage of total Expenditure under Abstract "B".
Abstract and Minor head.					
E. I		General Administration			
II		Ordinary Repairs and Maintenance ..			
III		Operating Expenses			
	1	Salaries, Wages and Allowances—			
		(a) General Operating Staff ..			
		(b) Station Staff			
		(c) Train Staff			
		(d) Miscellaneous			
	2—3	Lighting, water and general stores ..			
	4	Clothing			
	5	Stationery, forms and tickets ..			
		Miscellaneous expenses			
		Total Operating Expenses ..			
IV		Replacement and Renewal			
	1	Equipment			
		Total Expenses of Traffic Department			

N. L. S.

Railway.

Gauge.

Length.

Miles.

TABLE "F."

Expenses of General Departments.

Reference to Accounts.		Details.	Total Amount.	Per train Mile.	Percentage of Gross Earnings.
Abstract and minor head.	Sub-head.				
F. I.		General Administration ..			
II		Ordinary Repairs and Maintenance			
	1 and 2	Telegraph and Equipment ..			
		Total Expenses of General Department.			

TABLE "G."

Miscellaneous Expenses.

Reference to Accounts.		Details.	Total Amount.	Cost per train Mile.	Percentage of Gross Earnings.
Abstract and minor head.	Sub-head.				
G. I.		General Administration ..			
III		Operating Expenses			
		Total Miscellaneous Expenses ..			

Working Expenses of Branch.....

Do. do. per train Mile.....

Do. do. per mile per week....

Railway.
Gauge.
Length. Miles.

ESTIMATE OF FINANCIAL PROSPECTS

IN THE

Sixth year after opening to Traffic.

- (a) Capital Cost (including junction arrangements and interest on capital during construction).
- (b) Gross Earnings of Branch.
- (c) Gross Earnings of Existing Lines from new traffic interchanged with branch.
- (d) Working Expenses of Branch.*
- (e) Working Expenses of Existing Lines for new traffic interchanged with branch.†
- (f) Net Earnings of Branch ($b-d$).
- (g) Net Earnings of Existing Lines on new traffic interchanged with branch ($c-e$).
- (h) Net income creditable to branch ($f+g$).
- (i) Percentage return on capital ($\frac{h}{a} \times 100$).

* Working Expenses of Branch should include 5 per cent. of the Gross Earnings of the branch, when the capital cost does not provide for rolling stock.

† The ratio of Working expenses to Gross Earnings for interchanged traffic should be that prevailing on the existing lines concerned.

TABULATED DETAILS.
STANDARD FORMS.
(N. L. 10 TO N. L. 15.)

N. L. 10.
Railway.
Gauge.
Miles.

Length.

CURVE ABSTRACT.

Degree of curvature and radius.	Whole line.Miles.			Section I. Mile to Mile.			Section II. Mile to Mile.			Section III. Mile to Mile.		
	Number of each.	*Length in miles.	Total curvature degrees.	Number of each.	*Length in miles.	Total curvature degrees.	Number of each.	*Length in miles.	Total curvature degrees.	Number of each.	*Length in miles.	Total curvature degrees.
.....												
.....												
.....												
.....												
Total ..												
Ratio of curve to total length of line ..			 per cent.			 per cent.			 per cent.			 per cent.
Average amount of curvature per mile ..			 degrees.			 degrees.			 degrees.			 degrees.

* Length of primary curves, see paragraphs 11 to 15, pages 14 and 15, also paragraphs 25 to 30 of Chapter I of Technical Paper No. 256.

N. L. 11.
Railway.
Gauge.
Miles.

Length.

GRADIENT ABSTRACT.

Gradient.	Whole Line Miles.			Section I. Mile to Mile.			Section II. Mile to Mile.			Section III. Mile to Mile.		
	Number of each.	Length in miles.	Percentage of total length of line.	Number of each.	Length in miles.	Percentage of total length of line.	Number of each.	Length in miles.	Percentage of total length of line.	Number of each.	Length in miles.	Percentage of total length of line.
..												
..												
..												
..												
..												
..												
Level ..												
Total ..												
Steepest grade												
Longest continuous length of steepest grade ..												
Followed by												
For												

Length.

Length.

Length.

N. L. 13.
Railway.
Gauge.
Miles.

N. L. 13.
Railway.
Gauge.
Miles.

Railway.

Gauge.

Miles.

Length.

FIXED STATION MACHINERY.

PARTICULARS.

Name of Station.

N. L. 15.

Railway.

Gauge.

Length.

Miles.

STATIONS AND STATION SITES.

[illegible]

CONSTRUCTION ESTIMATE.
STANDARD FORMS.
(N. L. 16 TO N. L. 47.)



x 415
1126

N. E. 10.	Railway.
	Gauge.
Length.	Miles.

N. L. 17.
Railway.
Gauge. *✓*
Miles.

I.—STRUCTURAL ENGINEERING WORKS.

(i) Preliminary Expenses.

[Reasons for rates are given on page .]

Detailed Heads.	Whole line.....miles.		Section I.		Section II.		Section III.	
	Rate per mile.	Total cost.	Rate per mile.	Total cost.	Rate per mile.	Total cost.	Rate per mile.	Total cost.
(a) Survey Expenses ..								
(b) Plant								
(c) Establishment ..								
TOTAL ..								

I.—STRUCTURAL ENGINEERING WORKS.

(2) LAND.

[Reasons for rates are given on page .]

Description.	Unit.	Rate.	Whole line.....miles.		Section I.		Section II.		Section III.	
			Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
	Acre.	Rs.	Acres.	Rs.	Acres.	Rs.	Acres.	Rs.	Acres.	Rs.
.....										
.....										
.....										
.....										
.....										
.....										
TOTAL COST				Rs.		Rs.		Rs.		Rs.

Add.....on account of pay, allowances,
etc., of Land Valuation Staff ..

<i>Add 5 per cent. for contingencies</i> ..	..
--	-----------

Total . .

Rate per mile. . .

N. L. 18.	Railway.	Gauge.	Miles.
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
55	55	55	55
56	56	56	56
57	57	57	57
58	58	58	58
59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
67	67	67	67
68	68	68	68
69	69	69	69
70	70	70	70
71	71	71	71
72	72	72	72
73	73	73	73
74	74	74	74
75	75	75	75
76	76	76	76
77	77	77	77
78	78	78	78
79	79	79	79
80	80	80	80
81	81	81	81
82	82	82	82
83	83	83	83
84	84	84	84
85	85	85	85
86	86	86	86
87	87	87	87
88	88	88	88
89	89	89	89
90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

(a) Earthwork.

[Reasons for rates are given on page .]

54

N. L. 18.

Railway.

Gauge.

[Reasons for rates are given on page .]

55

NOTE.—Each tunnel is to be estimated for separately, each different class of work appearing as a distinct item with its own quantities, rate and cost.

I.—STRUCTURAL ENGINEERING WORKS.

(3) FORMATION.

(c) Walling.

Railway.

Gauge.

Length. Miles.

[Reasons for rates are given on page .]

Particulars.	Whole line, miles.		Section I.		Section II.		Section III.	
	Quantity.	Amount.	Quantity.	Amount.	Quantity.	Amount.	Quantity.	Amount.
Excavation		Rs.		Rs.		Rs.		Rs.
Concrete								
Masonry								
Total ..								
Contingencies								
Grand total ..								

I.—STRUCTURAL ENGINEERING WORKS.

(3) FORMATION.

(d) Side Drains.

N. L. 21.

Railway.

Gauge.

Miles.

[Reasons for rates are given on page .]

Length.

Description.	Unit.	Rate.	Whole line, miles.		Section I.		Section II.		Section III.	
			Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
Side drains in earth		Rs.		Rs.		Rs.		Rs.		Rs.
" in murem										
" in rock										
Total ..				Rs.		Rs.		Rs.		
Add for contingencies, 5 per cent. ..										
Grand total ..										
Mean rate per mile ..										

N. L. St.	Railway.	Gauge.	Miles.
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44
45	46	47	48
49	50	51	52
53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100

(a) Major Bridges.

[Reasons for rates are given on page .]

Length.

58

NOTE.—Each Major Bridge must be estimated for separately; the extra cost of providing for cart, animal or foot traffic is to be shown separately.

ST. N.

Railway.

(b) Minor bridges costing less than Rs. 5,000 each.

[Reasons for rates are given on page .]

Length.

Miles.

59

I.—STRUCTURAL ENGINEERING WORKS.

(4) BRIDGE WORK.

(b) Minor Bridges (costing more than Rs. 5,000 each).

[Reasons for rates are given on page].

N. L. 24.
Railway.
Gauge.
Miles.

Length.

Sub-section of Railway	Mileage.	Description.	Steel work.	Masonry.						Miscellaneous.		Total cost.
			Girders.	Excavation filling and backing.	Concrete.		Brickwork and masonry.		Flooring.	Timber.		
					Dry foundations.	Wet foundations.	Open foundations, super-structure and deep Wall.	Arching skewbacks and coping.				
		Two arches.....ft.	Tons.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	Rs.
		One arch.....ft.										
		One arch.....ft.										
		Two arches.....ft.										
		One girder.....ft.										
		Two girders.....ft.										
		One arch.....ft.										
		Total quantities										
		Rate, Rs.										
		Per	Ton.	100 C. ft.		100 C. ft.	100 C. ft.	100 C. ft.	100 C. ft.	100 C. ft.	C. ft.	
		Amount, Rs.										
Add for contingencies, 5 per cent.												
Add for bridges costing less than Rs. 5,000 each, page 59.												
.....to....., rate per mile Rs.....Total cost Rs.												

Add for contingencies, 5 per cent.

Add for bridges costing less than Rs. 5,000 each, page 59.

.....to....., rate per mile Rs.....Total cost Rs.

I.—STRUCTURAL ENGINEERING WORKS.

(3) FORMATION AND (4) BRIDGE WORK.

Cost mile by mile.

N. L. 25.
Railway
Gauge.
Miles.

Length.

Miles.	BANKS.			CUTTINGS.			3 (a)		3 (b)	3 (c)	3 (d)	(4) BRIDGE WORK.		Total (3) Formation and (4) Bridge work, exclusive of 5 per cent. for contingencies.
	Up to ft. high at Rs. per 1,000 c. ft.		Over ft. high at Rs. per 1,000 c. ft.	Trained earth at Rs. per 1,000 c. ft.		Earth up to ft. deep at Rs. per 1,000 c. ft.	Muram at Rs. per 1,000 c. ft.		Hard rock at Rs. per 1,000 c. ft.	3 (a)		Total (3) Formation.	(a) (i) Major Bridges.	(b) Minor Bridges.
	Quantity.	Cost.		Quantity.	Cost.		Quantity.	Cost.		Quantity.	Cost.			
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
Total														

NOTE.—The numbers of all major and minor bridges and culverts, independent of span should be consecutive in one series throughout the line.

I.—STRUCTURAL ENGINEERING WORKS.

N. L. 26.
Railway.
Gaugé.
Length.
Miles.

(5) FENCING.

(a) Fencing.

[Reasons for rates are given on page .]

Description.	Unit.	Rate.	Whole line, miles.		Section I.		Section II.		Section III.	
			Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
Fencing	Mile ..	Rs. ..		Rs.		Rs.		Rs.		Rs.
Cattle-guards at stations and level crossings	Set ..									
Boundary marks	Mile ..									

62

Total ..	Rs.	Rs.	Rs.
Add for contingencies, 5 per cent. ..			
Grand total ..			
Mean rate per mile, Rs. ..			

NOTE.—The unit of one mile is to be taken as one mile in length of single fence, not fencing sufficient for both sides of a mile of railway.

I.—STRUCTURAL ENGINEERING WORKS.

N. L. 27.
Railway.
Gauge.
Miles.

(5) FENCING.

(b) Road Crossings.

[Reasons for rates are given on page .]

Description.	Unit.	Rate.	Whole line, miles.		Section I.		Section II.		Section III.	
			Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
Earthwork at level crossings	1,000 c. ft. ..	Rs. ..		Rs.		Rs.		Rs.		Rs.
Gates, huts and guard rails at second class level crossings ..	Each ..									
Posts and guard rails at third class level crossings	Each ..									
Metalling second class crossings and Public Works Department road diversions	Lin. ft. ..									
Bridges in road diversions	Lin. ft. ..									

63

Total ..	Rs.	Rs.	Rs.
Add for contingencies, 5 per cent. ..			
Grand total ..			
Mean rate per mile, Rs. ..			

7

Description.	Unit.	Rate.	Whole line, miles.		Section I.		Section II.		Section III.	
			Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
Mile posts	Each	Rs.	..	..	..	Rs.	..	Rs.	..	Rs.
Gradient posts	"	..	..	..	..	..	..	..	..	..
Telegraph—post number—plates	"	..	..	..	..	..	..	..	..	..
				Total	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
				Add for contingencies, 5 per cent.						
				Grand Total						
				Mean rate per mile, Rs.						

65

N. L. 29.

Railway.

Gauge.

Miles.

Length.

I.—STRUCTURAL ENGINEERING WORKS.

(6) ELECTRIC TELEGRAPH.

[Reasons for rates are given on page .]

Description.	Unit.	Rate.	Whole Line Miles.	
			Quantity.	Cost.
Electric Instruments				
Telephones				
Train Control Equipment				
Total Rs. ..				
Add 5 per cent. for contingencies ..				
GRAND TOTAL Rs. ..				
Rate per mile Rs. ..				
Whole line. Rate per mile Rs. . Section I ,, ,, ,, Rs. . ,, II. ,, ,, ,, Rs. . ,, III. ,, ,, ,, Rs. .				

I.—STRUCTURAL ENGINEERING WORKS.

N. L. 30.
Railway.
Gauge.
Miles.

Length.

[Reasons for rates are given on page .]

Description.	Unit.	Rate.	Whole Line, Miles.			Section I. Mile to Mile			Section II. Mile to Mile			Section III. Mile to Mile		
			Quantity.	Cost.	Rate per mile.	Quantity.	Cost.	Rate per mile.	Quantity.	Cost.	Rate per mile.	Quantity.	Cost.	Rate per mile.
(a) MAIN LINE :—														
(i) Rails and Fastenings ..														
Add for contingencies, 5%														
Total														
(ii) Sleepers and Fastenings :—														
(a) Sleepers :—														
(1) Wood ..														
(2) Cast-iron and ferro-concrete.														
(3) Steel trough ..														
Add for contingencies, 5%														
Total														
(b) Fastenings ..														
Add for contingencies, 5%														
Total														
(iii) Ballast ..														
Add for contingencies, 5%														
Total														
Total I (7) (a)														

(b) Sidings :—														
(i) Rails and Fastenings ..														
Add for contingencies, 5%														
Total														
(ii) Sleepers and Fastenings :—														
(a) Sleepers :—														
(1) Wood ..														
(2) Cast-iron and ferro-concrete.														
(3) Steel trough ..														
Add for contingencies, 5%														
Total														
(b) Fastenings ..														
Add for contingencies, 5%														
Total														
(iii) Ballast ..														
Add for contingencies, 5%														
Total														
Total I (7) (b)														
(c) Electric Track Equipment :—														
Add for contingencies, 5%														
Total														
Total I (7) (c)														

Description.	Unit.	Rate.	Whole Line, Miles.			Section I.			Section II.			Section III.		
			Quantity.	Cost.	Rate per mile.	Quantity.	Cost.	Rate per mile.	Quantity.	Cost.	Rate per mile.	Quantity.	Cost.	Rate per mile.
(c) Points and Crossings :—														
(i) Points and Crossings ..														
Add for contingencies, 5% ..														
Total ..														
(ii) Crossing sleepers and Fastenings—														
(a) Sleepers—														
(1) Wood ..														
Add for contingencies, 5% ..														
Total ..														
(b) Fastenings ..														
Add for contingencies, 5% ..														
(iv) Maintenance during construction														
Total ..														
Total I (7) (c) ..														

N. L. 31.
Railway.
Gauge.
Miles.

Length.

I.—STRUCTURAL ENGINEERING WORKS.

(7) BALLAST AND PERMANENT-WAY.

Detailed Estimate of one Mile of Track (Ballast and Permanent Way).

Standard of Track :—

Main Line :—Rails lbs. per yard. Sidings :—Rails lbs. per yard.
Sleepers per mile. Sleepers per mile.
Ballast cubic feet per foot run. Ballast cubic feet per foot run.

Details.	Quantity.	Unit.	Rate.	Amount.	Remarks.
(a) Main Line :—					
Total cost of one mile of Track (Main Line).					
(b) Sidings :—					
Total cost of one mile of Track (Sidings).					

NOTE.—This estimate should be made out for one mile of completed track, including Ballast and all charges for handling linking and maintenance during construction.

I.—STRUCTURAL ENGINEERING WORKS.

(8) STATIONS AND BUILDINGS.

(a) Stations and Offices.

[Reasons for rates are given on page .]

N. L. 32.

Railway.

Gauge.

Length.

Miles.

Section of Estimate and Name of Station.	Masonry Buildings.									All Others.									Total.
	Plinth Area.	Rate per sq. ft.	Cost.	Plinth Area.	Rate per sq. ft.	Cost.	Plinth Area.	Rate per sq. ft.	Cost.	Plinth Area.	Rate per sq. ft.	Cost.	Plinth Area.	Rate per sq. ft.	Cost.	Plinth Area.	Rate per sq. ft.	Cost.	
Section I—																			
Section II—	Section I— . Miles. Rate per Mile Rs. Total ..																		
Section III—	Section II— Miles. Rate per Mile Rs. Total ..																		
	Section III— Miles. Rate per Mile Rs. Total ..																		
Whole Line. Rate per Mile Rs. Total ..																			

NOTE.—The estimates are to be made up by stations or by groups of buildings, where not intended for station purposes under the head "Masonry Buildings" will be included all buildings whose foundations and superstructure generally are of masonry and which are built according to the specification prescribed by the Railway Administration for buildings of a permanent character.

I.—STRUCTURAL ENGINEERING WORKS.

N. L. 34.

(8) STATIONS AND BUILDINGS.

(c) **Electric Power Stations and Sub-Stations Buildings.**

[Reasons for rates are given on page .]

Length.

Railway.
Gauge.

Gauge.

Miles.

[illegible]

NOTE.—Estimates are to be made out for each group or set of buildings separately. For classification of "Masonry buildings" see note below Form N. L. 32 "Stations and Offices".

Whole Line	miles.	Rate per mile	Rs.
Section I	miles.	Rate per mile	Rs.
Section II	miles.	Rate per mile	Rs.
Section III	miles.	Rate per mile	Rs.

I.—STRUCTURAL ENGINEERING WORKS.

K. L. 35.

(8) STATIONS AND BUILDINGS.

Railway Gauge.

(d) Residential Buildings.

Gauge.
Miles.

[Reasons for rates are given on page .]

Length.

Miles.

Section of Estimate and Name of Station.	Masonry Buildings.						All others.						Total.
Section I—	Plinth Area.	Rate.	Cost.	Plinth Area.	Rate.	Cost.	Plinth Area.	Rate.	Cost.	Plinth Area.	Rate.	Cost.	
Section II—	Section I. Rate per mile Rs.												Total ..
Section III—	Section II. Rate per mile Rs.												Total ..
	Section III. Rate per mile Rs.												Total ..
Whole line miles. Rate per mile Rs.													Total ..

73

NOTE.—Estimates are to be made out for each group or set of buildings separately. For classification of "Masonry Buildings" see note below Form N. L. 32 "Stations and Offices."

Railway. I.—STRUCTURAL ENGINEERING WORKS.

Gauge. (8) STATIONS AND BUILDINGS.

Length.	Miles.	(e) Fixed Station Machinery.
---------	--------	------------------------------

[Reasons for rates are given on page .]

Section of Estimate and Name of Station.	Particulars.								Total.
		Cost.		Cost.		Cost.		Cost.	
Section I—									
	Section I. Rate per mile Rs. Total ..								
Section II—									
	Section II. Rate per mile Rs. Total ..								
Section III—									
	Section III. Rate per mile Rs. Total ..								

Whole line	miles.	Rate per mile Rs.
------------	--------	-------------------

Total ..

NOTE.—Estimates are to be made out by stations, each individual structure appearing as a distinct item.

Railway.

Gauge.

Miles.

Length.

I.—STRUCTURAL ENGINEERING WORKS.

(9) Shore Connections for Ferry Steamers.

[Reasons for rates are given on page .]

[illegible]

Whole line		, Rate per mile Rs.	
Section I		' "	" " "
" II		' "	" " "
" III		' "	" " "

N. L. 38.

Railway

Gauge.

Length.

Miles.

I.—STRUCTURAL ENGINEERING WORKS.

(10) Plant—Construction.

[Reasons for rates are given on page .]

Description.	Quantity.	Rate.	Per	Total.
Plant for construction			Mile.	
Plant for important Major Bridges ..				
.....			Each.	
.....				
.....			"	
.....			"	
Credit on completion of construction..				
Total ..				

Whole line , Rate per mile Rs.

N. L. 39.

Railway.

Gauge.

Miles.

Length.

II.—EQUIPMENT.

[Reasons for rates are given on page .]

Description.	WHOLE LINE				MILES.		
	Unit.	Rate.	Quantity.	Amount.	Add 5 per cent. for contingencies.	Grand Total.	Rate per mile.
(1) Plant—							
(a) Engineering ..							
(b) Locomotive ..							
(c) Carriage and Wagon							
(d) Electric Traction Power Station and Sub-Stations.							
(e) Electric							
(f) Miscellaneous ..							
 Total Rs. ..							
(2) Station and Office Fur- niture.							
(3) Motors, Lorries, Steamers or Boats.							
 Grand Total ..							

H8TO

Whole line			Miles	Rs.
Section	I	..	..	..
"	II	..	"	"
"	III	..	"	"

Length. Railway.
Gauge.
Miles.

III.—ROLLING STOCK.

Description.	NUMBER.		Each.	Amount.
	Bogie.	4-Wheeler.		
			Rs.	Rs.
(1) Rail—				
(a) Locomotive :—				
(i) Engines and Tenders				
(ii) Boilers				
(iii) Electric				
(b) Carriage and Wagon :—				
(i) Coaching Vehicles				
(ii) Goods Vehicles				
(c) Motor Vehicles				
(2) Motor Vehicles—Road				
(3) Ferries :—				
(a) Steam Boats				
(b) Barges and Minor Craft				
Total ..				
Whole line	Rate per mile Rs.			

Length.

IV.—GENERAL CHARGES.
(1) Salaries and Allowances.

Description.	Number.	Salary.	Period in Months.	Amount.
(a) Direction and General. Details of charges :—				
Total, Direction and General ..				
(b) Engineering. Details of charges :— [e.g., Executive Engineer. Asst. Executive Engineer. Inspector of Works. Travelling Allowance. Leave Allowance. Provident Fund Bonus.]				
Total, Engineering ..				
(c) Audit and Accounts. Details of charges :—				
Total, Audit and Accounts ..				
(d) Stores. Details of charges :—				
Total, Stores ..				
(e) Medical and Sanitation. Details of charges :—				
Total, Medical and Sanitation ..				
Total, IV (1) Salaries and Allowances				

(2) Office Expenses.

Description.	Quantity.	Rate.	Per	Amount.
(a) Accommodation. Details of charges :— [e.g., Executive Engineer's Office. Furniture. Temporary Store Sheds. Temporary Dispensary.]				
Total, Accommodation ..				
(b) Contingencies. Details of charges :				
Total, Contingencies ..				
Total IV (2) Office Expenses ..				

(3) Residential Quarters.

Description.	Plinth Area.	Rate per Sq. ft.	Amount.
Total, IV (3) Residential Quarters			..

Railway.	Gauge.	Miles.
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Length.

IV.—GENERAL CHARGES.

[illegible]

N. L. 45.
Railway
Gauge.
Miles.

Length.

IV.—GENERAL CHARGES.

(5) General charges on Stores.

Description.	Quantity.	Rate.	Per.	Amount.
Total, IV (5) General Charges on Stores ..				

[Rs. per mile has been adopted as the rate per mile for reasons given on page

Total, General Charges, Rs. ..

Whole Line	..	..	..	..	..	Miles.	Rg.
Section I	..	..	..	..	..		
Section II	..	..	..	..	..		
Section III	..	..	..	..	..		

[illegible]

[illegible]

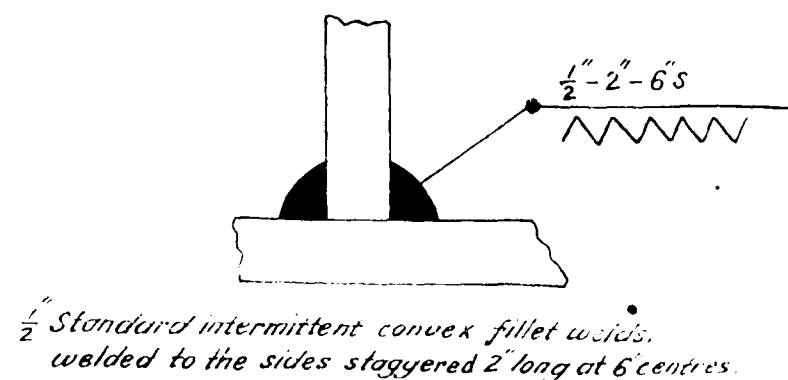
Conventional Signs.

Symbols for fusion welds.			
Location.	Standard fillet welds.	Butt welds.	
		Reinforced	Bevel.
Near Side.	XXXXXX	XXXXXX	XXXXXX
Far Side.	TTTTTTTT	TTTTTTTT	TTTTTTTT
Both Sides.	XXXXXX	XXXXXX	XXXXXX
All round.	XXXXXX	TTTTTTTT	XXXXXX
Erection weld (near side)	XXXXXX	TTTTTTTT	TTTTTTTT

Method of Showing Symbols on Drawings.

Shop weld near side	Erection welds far side			
$\frac{1}{2}$ standard continuous fillet weld 2' long	$\frac{3}{8}$ standard intermittent fillet erection welds on the far side 2' long at 6' centres.	$\frac{1}{2}$ standard continuous reinforced fillet erection weld on the far side 6' long.	$\frac{3}{8}$ standard intermittent fillet welds 2' long at 6' centres staggered with respect to each other on opposite sides.	$\frac{3}{8}$ standard continuous erection weld all round.

Method of indicating weld sections on large drawings



APPENDIX II.

Standard method of indicating Arc Welds on drawings.

- General.**—No attempt should be made to draw the welds on the drawings. The joint should be connected by a bent arrow to some clear space preferably outside the drawing and the details regarding type and size, etc., shown there in accordance with the conventional signs detailed below.
- In the case of special reinforced welds, a free hand dimensioned sketch should always be given showing all details of the weld. The sketches should be indicated by conventional signs detailed below. If further description is needed, it should be given in words and in any case where there is space on the drawing, it is desirable to describe in words in addition to the using of the conventional signs.

APPENDIX III.

1. In every booth where welding work is done there shall be hung a notice in red letters drawing the attention of the welders as well as outsiders to the danger of striking or looking at an electric arc with eyes unprotected. All welders should be instructed to protect their eyes with suitable face shields before starting works on welding. They should also be instructed to warn their workmen and others within a range of 20 yards of the danger of looking at the arc.

2. Persons not engaged in welding should not be allowed to stay in welding booths.

3. Operators should be warned to protect themselves from the electric current and the electrical appliances lying in a welding booth.

E. I. 653-500-27-8-36-EIR.

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